Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

LISTS OF SPECIES

Floral diversity of Baanganga Wetland, Uttarakhand, India.

Bhupendra S. Adhikari
Mani M. Babu

Herbarium section, Habitat Ecology Department, Wildlife Institute of India. P.O. Box # 18. Chandrabani, Dehradun 248 001, Uttarakhand, India. E-mail: adhikaribs@wii.gov.in

Abstract: Baanganga wetland, a 45 km long channel originates near Bishenpur and flows in Idrishpur-Chakheri forest block of Haridwar district in Uttarakhand, India represents riverine ecosystem. The study area harbors many islands, varying in shape and size, which remains underwater during the rainy season and provide a good habitat to various plant taxa, birds (resident as well as migratory) and animals mainly Swamp deer (*Cervus duvauceli duvauceli*), a critically endangered species and Hog deer (*Axis procinus*). To asses the status and distribution of flora, trips were conducted in the intensive study area. The plants were classified based on their habit and their presence was visually observed. A total of 178 plant species were recorded, of which 40 species (hydrophytes) were found in aquatic habitat, 122 species on moist shores and 117 species in upland habitat. *Phragmites karka, Polygonum barbatum, Ipomoea carnea*, and *Typha elephantina* were the most common species in all the habitats. The majority of plants (40) are from Indian oriental region. The moist shore and upland habitats had maximum similarity (64 %) followed by aquatic and moist shore (26 %) habitats. The status of flora and management of Baanganga wetland ecosystem has been discussed in the paper.

Introduction

Wetland ecosystem forms an important environment for aquatic, semi-aquatic and moisture loving floral and faunal associations. In tropical and sub-tropical wetlands infestation of aquatic plants is globally known. They act as bio-filter, as they intake large amount of organic as well as inorganic nutrients from the eutrophic water bodies/nutrient enriched pollutant through various dynamic processes, e.g. water cycle, nutrient cycle and food chain, therefore, known as '*Kidney of the Landscape*' or '*Biological Super Market*' by the experts or the areas where the soil is saturated with water are crucial incubators known for high species diversity (Allen-Diaz et al. 2004).

Human activities, such as modern agriculture and aquaculture emphasized more involvement in wetland ecosystems, therefore, these less important plants of wetland apparently designated as 'weed'. The weed flora provides an indigenous source of chief fertilizers, which acts as soil conditioner, when utilized as compost manure (Naskar 1990). The wetlands are also important for their importance in birds' migratory route as well as habitat to resident birds. Wetlands are important to natural cycles involving water, nitrogen, sulfur and complex food chain. The nutrient rich soil and plants form buffer against global climate change, as it stores carbon instead of releasing it. By promoting carbon sequestration and nutrient conservation from the terrestrial landscape the high productivity of herbaceous plants, which is the major factor for maintaining ecosystem services, can be achieved.

In wetland ecosystem, the vegetation chiefly weeds are responsible for chocking, which do not allow water animals such as fish and turtle to move freely, reduce the productivity by preventing sunlight to reach down to bottom soil and depleting nutrients, lowering down the amount of dissolved oxygen and provide shelter to many organisms, e.g. pathogens and parasites. Contrary to this, wetland vegetation enrich the water bodies as natural organisms, mainly aquatic plants develop simultaneously after decaying, plants (mainly weeds) grow along the margins and shore vegetation protect the edge from water current and rain flashing, provide food to human beings and used in different ailments as medicine in rural areas. Wetland plants vary in shape and size, ranging from microscopic to multi-cellular form, mainly herbaceous, occasionally shrubby in nature and mostly perennial. The current status of floral diversity in various habitat types and management of Baanganga wetland ecosystem is being attempted in the paper.

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

Materials and Methods

Study area

The holy river Ganga enters in to the plain area first in Haridwar, a holy place for Hindus after churning the mountains in Uttarakhand, India. A 45 km long channel originates near Bishenpur and flows in Idrishpur-Chakheri forest block, meets again in Ganga River, known as Baanganga, represents riverine wetland ecosystem (Figure 1). Albeit, the remnant wetlands are still considered as major habitat for wintering waterfowls, and are surrounded by large chunk of agricultural fields and human settlements, due to which these remnant wetland ecosystem have been completely diminished.

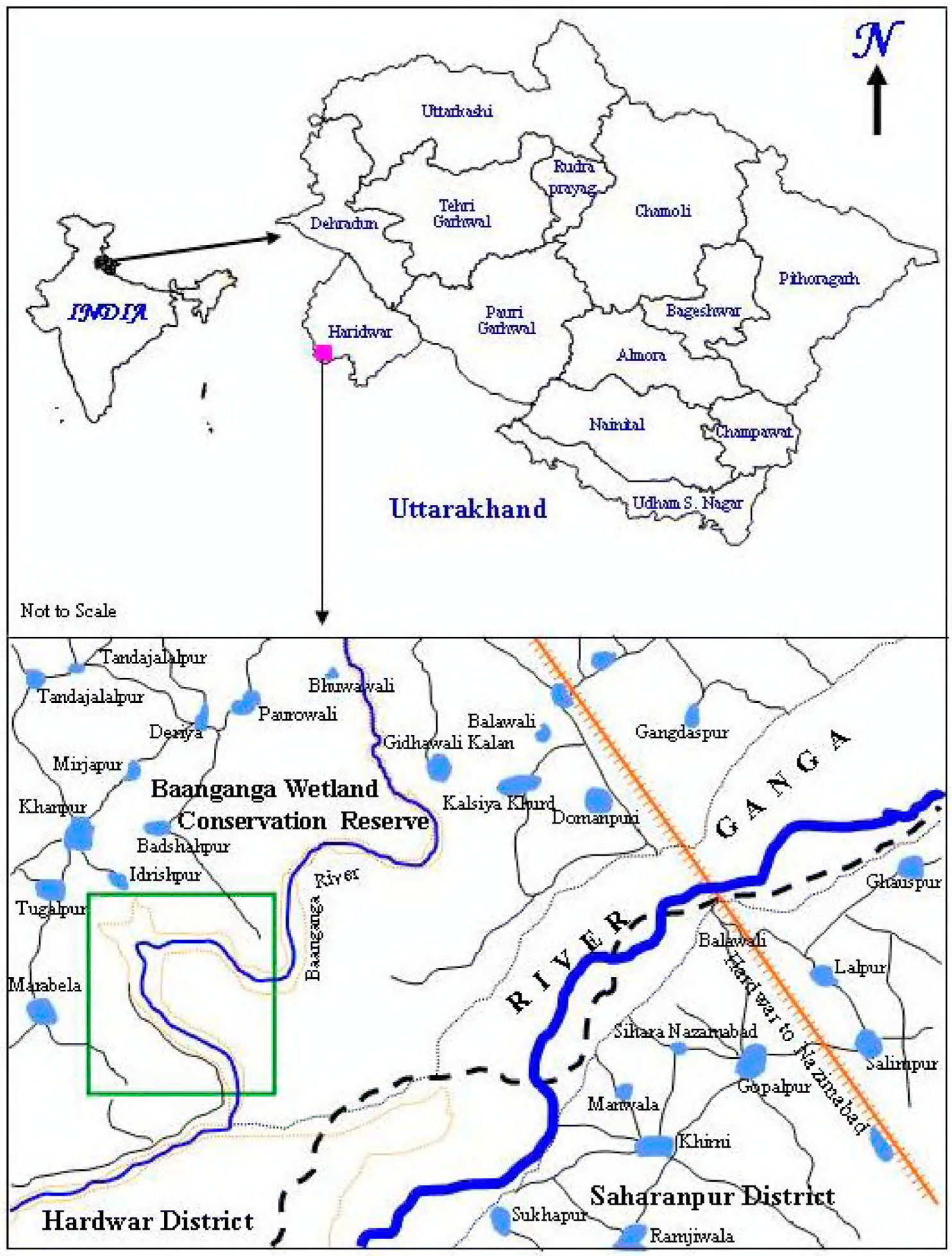

Figure 1. Location of Baanganga wetland in Uttarakhand, India. The study area is encircled with dotted lines.

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

LISTS OF SPECIES

The study area is located 70 km from Haridwar on Haridwar-Laksar-Purkaji road with an area spread over 8 km^2. The intensive study was conducted along the Baanganga River between 78º2'43" E to 78º2'15" E and 29º38'1" N to 29º36'01" N, which covers *ca.* 0.32 km^2 (approx. 8 km in length and average width 40m). The study area (Figure 2) harbors several islands, varying in shape and size, which remains underwater during the rainy season and provide a good habitat to Swamp deer (*Cervus d. duvauceli*), a critically endangered species in Red Data Book (IUCN), Hog deer (*Axis procinus*) and Otter (*Lutra lutra*). These islands are mainly dominated by species like *Phragmites karka*, *Ipomoea* sp., *Polygonum barbatum*, and *Polygonum glabrum*. In few localities the river is deep and narrow, while the area between islands is shallow, full of decomposed *Eichhornea* and elevated land away from the river mainly dominated by *Typha*. Among free floating plants (*Azolla, Eichhornia*, and *Lemna*), semi-submerged (rooted plants with aerial float; *Enydra, Ludwigia*, *Potamogeton*, *Nymphaea*, *Nymphoides*, *Marsilea*, and *Trapa*), submerged (*Ceratophyllum*, *Hydrilla*, *Najas*, *Potamogeton* spp. and *Vallisneria*) and moist loving plants (*Ipomoea* sp., *Typha*, *Monochoria*, *Phragmites*, *Polygonum* spp., *Rotala, Rumex*, and *Sagitaria*) can be seen in the study area. The infestation of weeds (*Eichhornia crassipes*, *Enydra fluctuans*, and *Ipomoea etc.*) and agricultural fields in the Baanganga wetland are the major concern. Heavy weed growth raises the bed level due to silt deposition and impedes the free flow of water.

Several trips were made during 2006 between February-June to asses the status and distribution of vegetation in a part of Baanganga wetland. The entire study area was divided in to five different land use categories, water bodies, marshy area, islands, moist shores and upland. For the sake of convenience the entire area was further divided in to segments to carry out the survey properly to prepare the checklist. The plants were identified based on the Illustrated flora of Keoladeo National Park, Bharatpur (Babu 1977), Flora of the Upper Gangetic Plain (Prasad *et al.* 1996) and Herbaceous Flora of Dehradun (Duthie 1903-29).

Figure 2. Panoramic view of Baanganga wetland (A); a major threat to wetland habitat (B); better management of wetland by removing excessive weed (*Eichhornia crassipes*) (C); and Dusk at Baanganga wetland (D).

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

LISTS OF SPECIES

The hydrophyte (plants growing in water bodies) has been classified in to four categories is as follows: **f:** *free floating plants* or parts of plants floating; **s:** *submerged plants* (plants under water); **ss:** *semi-submerged plants* (rooted plants with aerial float/plant part under water), and **ml:** *moisture loving plants* along the edge of the water body. The status of plants in relation to study area has been categorized as frequent (F), occasional (O) and rare (R), which are rarely found in the study area. The nativity of plants of study area was documented through *Index Kewensis Plantarum Phanerogamarum* (Anonymous 1883-1885; 1886-1970).

The cover percent of dominant species was recorded in each habitat type through randomly placed five 1x1 m quadrate and for each habitat type five sites were selected.

Results and Discussion

Land use pattern

Of the entire study area water bodies cover 55 %, marshy area 4 %, islands 15 %, moist shores 8 % and upland 18 %. The percent cover of vegetation, water and open area in each habitat type is given in Table1. The status of different taxa (Figure 3) suggests that most of the species were frequently distributed, except trees in the study area.

Table 1. Vegetation and water cover percentage in different land use categories.

Habitat type	Percent cover		
	Water	Vegetation	Open
Water body	70	30	—
Marshy area	15	75	10
Island	10	75	15
Moist shore	—	85	15
Upland	—	70	30

Classification of plants

A total of 178 plant species were recorded from a part of Baanganga wetland. Of the total species, 40 species (hydrophytes) were in aquatic habitat, 122 species on moist shores and 117 species were in upland habitat. Among hydrophytes, four are free floating, eight submerged, seven semi-submerged, five semi-submerged with floating plant parts, three semi-submerged as well as moist loving and 13 moist loving. A list of plant species recorded in Baanganga wetland is given in Table 2 along with collection number, family, nativity, habit and their distribution status.

Figure 3: Distribution of different taxa in Baanganga wetland.

Nativity

The trend of nativity of plants occurring in Baanganga wetland is as follows: Indian oriental region (40) > cosmopolitan (20) > Asia-Africa-Australia region (18) > European/Oriental and Gerontia region (16 each) > America-Australia tropical region (13) > Amphigaea tropical region (9). However, 38 species are from different parts of the world and nativity of 8 species is not known (Table 2).

Habitat Specificity

The site specific distribution of plants based on their habitat preference is given in Table 3; however, it is not necessary that the plants will be restricted in these habitats only. The plant species which are common in all habitats are *Phragmites karka*, *Polygonum barbatum*, *Ipomoea carnea*, and *Typha elephantina*. However, 19 species were restricted to aquatic habitat, 25 species along seasonally inundated shores and 37 species were found in the upland habitats. The similarity (%) between habitats is in following order: moist shore and upland (64 %) > aquatic and moist shore (26 %) > aquatic and upland (5 %).

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

LISTS OF SPECIES

Table 2. List of plants recorded in Baanganga wetland. Habit: tree (T), shrub (S), herb (H), and grass (G); hydrophytes: free floating plants (f), submerged plants (s), semi-submerged plants (ss), and moisture loving plants (ml); status: frequent (F), occasional (O), and rare (R); habitat: aquatic (AqT), moist shore (MoS), and upland (UpL); nativity: Afghanistan (Afghan), Africa (Afr), Algeria (Alger), America (Am), Amphigaea (Amphig), Arabia (Arab), Arctic (Arct), Asia (As), Australia (Austr), Boreal (Bor), Brazil (Braz), Central (Centr), Cosmopolitan (Cosmop), Cultivated (Cult), Europe (Europ), Gerontia (Geront), Himalayan Region (Reg Himal), Indian Oriental (Ind Or), Insular (Ins), Madagascar (Madag), Mediterranean (Mediterr), Occidentalis (Occ), Oriens (Oriens), Oriental (Orient), Pacific (Pacif), Philippines (Philipp), Subtropical (Subtrop), Temperate (Temp), Territorial (Terr), and Tropical (Trop); et = and.

Coll. No.	Scientific name	Family	Nativity	Habit	Habitat	Status
10705	*Hygrophila polysperma* (Roxb.) T. Anders.	Acanthaceae	Ind. or.; Malaya	H	AqT, MoS	F
10836	*Rungia parviflora* (Retz.) Nees.	Acanthaceae	Ind. or.; Burma	H	MoS, UpL	O
10858	*Rungia pectinata* (L.) Nees	Acanthaceae	Ind. or.; Burma	H	UpL	F
10719	*Sagitaria sagitifolia* L.	Alismataceae	Europ.; As.; Am. bor	H	AqT, MoS	F
10744	*Achyranthes aspera* L.	Amaranthaceae	Geront. trop	H	MoS, UpL	F
10777	*Alternanthera paronychioides* St. Hill.	Amaranthaceae	Am.austr	H	MoS, UpL	F
10702	*Alternanthera philoxeroides* (Mast.) Griseb.	Amaranthaceae	Reg. Argent	H	AqT	O
10779	*Alternanthera sessilis* (L.) R. Br.	Amaranthaceae	Reg. trop	H	MoS, UpL	F
10868	*Amaranthus spinosus* L.	Amaranthaceae	Reg. trop	H	UpL	R
10835	*Centella asiatica* (L.) Urb.	Apiaceae	Reg. trop. et subtrop	H	MoS, UpL	F
10842	*Hydrocotyle sibthorpioides* Lamk.	Apiaceae	As. et Afr. Trop	H	MoS	O
10736	*Psamogeton canescens* (DC) Vatke.	Apiaceae	Oriens	H	MoS, UpL	F
10735	*Seseli diffusum* (Roxb.ex Sm.) Sant. & Wagh.	Apiaceae	Ind. or	H	MoS, UpL	O
10749	*Oxystelma secamone* (L.) Karst.	Asclepiadaceae	Austral	C	MoS	F
10730	*Ageratum conyzoides* L.	Asteraceae	Reg. trop	H	MoS, UpL	F
10771	*Ageratum houstonianum* Mill.	Asteraceae	Mexic	H	MoS, UpL	F
10811	*Bidens bitternata* (Lour.) Merr. & Sheriff	Asteraceae	China	H	MoS, UpL	F
10790	*Blumea laciniata* (Roxb.) DC.	Asteraceae	Ind. or.; Malaya; China	H	MoS, UpL	O
10863	*Blumea membranacea* DC.	Asteraceae	Ind. or.; Malaya	H	UpL	O
10875	*Blumea mollis* (D.Don) Merr.	Asteraceae	Geront. Trop	H	UpL	F
10747	*Centipeda minima* (L.) A. Br. & Asch.	Asteraceae	As. et Austral. trop.; Ins. Pacif	H	MoS, UpL	F
10834	*Cirsium arvense* (L.) Scop.	Asteraceae	Europ.; As. temp	H	MoS, UpL	O
10791	*Eclipta prostrata* L.	Asteraceae	Cosmop. trop	H	MoS, UpL	F
10876	*Elephantopus scaber* L.	Asteraceae	Cosmop. trop	H	UpL	R
10704	*Enydra fluctuans* Lour.	Asteraceae	Cochinch	H	AqT, MoS	F
10781	*Erigeron bonariensis* L.	Asteraceae	Am. austr	H	MoS, UpL	F
10787	*Gnaphalium pensylvanicum* Willd.	Asteraceae	Reg. trop. et subtrop	H	MoS, UpL	F
10788	*Gnaphalium polycaulon* Pers.	Asteraceae	Geront. Trop	H	MoS, UpL	F
10731	*Grangea maderaspatana* (L.) Poir.	Asteraceae	As. et Afr. Trop	H	MoS	F
10889	*Ixeris polycephala* Cass.	Asteraceae	Ind. or.; Burma	H	UpL	O
10888	*Launaea procumbens* (Roxb.) Ram. & Raj.	Asteraceae	Oriens; Ind. or	H	UpL	O
10829	*Parthenium hysterophorus* L.	Asteraceae	Am. bor. et austr	H	MoS, UpL	F
10896	*Pulicaria crispa* Sch.-Bip.	Asteraceae	Afr. bor. et trop.; Arab.; Ind. or	H	UpL	F
10775	*Sonchus asper* (L.) Hill.	Asteraceae	Cosmop	H	MoS, UpL	F
10866	*Sonchus oleracea* L.	Asteraceae	Cosmop	H	UpL	F
10815	*Tridax procumbens* L.	Asteraceae	Am. trop	H	MoS, UpL	O
10844	*Vernonia cinerea* (L.) Less.	Asteraceae	Amphig. trop	H	MoS	F
10887	*Xanthium strumarium* L.	Asteraceae	Cosmop	H	UpL	F

LISTS OF SPECIES

Table 2. Continued.

Coll. No.	Scientific name	Family	Nativity	Habit	Habitat	Status
10723	*Azolla pinnata* R. Br.	Azollaceae	Japonia. Asia; Austr.; Africa trop.;	H	AqT	F
10891	*Cordia dichotoma* Forst. f.	Boraginaceae	As. trop.; Austral	T	UpL	R
10729	*Cynoglossum zeylanicum* (Vahl.) Thunb. ex Lehm.	Boraginaceae	Ind. or. (Bengal)	H	MoS, UpL	O
10772	*Brassica junceae* (L.) Czern.	Brassicaceae	As Temp et Trop (Cult)	H	MoS, UpL	C
10784	*Coronopus didymus* (L.) Sm.	Brassicaceae	Cosmop	H	MoS, UpL	F
10808	*Rorippa nasturtium-aquaticum* (L.) Hayek	Brassicaceae	Reg. bor. Temp	H	AqT, MoS	F
10833	*Cassia tora* L.	Caesalpiniaceae	Cosmop. trop	H	MoS, UpL	F
10824	*Parkinsonia aculeate* L.	Caesalpiniaceae	Am. trop	T	MoS, UpL	R
10845	*Tamarindus indica* L.	Caesalpiniaceae	As. et Afr. trop	T	MoS	R
10893	*Campanula wallichii* Babu	Campanulaceae	Ind. or.; Afghan	H	UpL	R
10822	*Cannabis sativa* L.	Cannabinaceae	As. centr; Himal. bor. occ	H	MoS, UpL	F
10821	*Stellaria media* (L.) Vill.	Caryophyllaceae	Great Britain (Northern Europe)	H	MoS	F
10718	*Ceratophyllum demersum* L.	Ceratophyllaceae	Reg. temp. et trop	H	AqT	F
10793	*Chenopodium album* L.	Chenopodiaceae	Reg. temp. et trop	H	MoS, UpL	F
10818	*Chenopodium ambrosioides* L.	Chenopodiaceae	Reg. temp. et trop	H	MoS, UpL	O
10732	*Suaeda fruticosa* (L.) Forsk.	Chenopodiaceae	Reg. bor. temp	H	MoS, UpL	O
10816	*Terminalia arjuna* (Roxb.) Wt. & Arn.	Combretaceae	Ind. or	T	MoS	R
10748	*Commelina benghalensis* L.	Commelinaceae	Geront. trop	H	MoS, UpL	F
10795	*Commelina hasskarlii* Clarke	Commelinaceae	Ind. Or	H	MoS, UpL	F
10769	*Ipomoea carnea* Jacq.	Convolvulaceae	Am. austr	S	AqT, MoS, UpL	F
10770	*Ipomoea aquatica* Forsk.	Convolvulaceae	Geront. trop	C	MoS	F
10767	*Momordica dioica* Roxb. ex Willd.	Cucurbitaceae	Ind. Or	C	MoS, UpL	F
10776	*Carex* sp.	Cyperaceae		H	AqT, MoS	C
10802	*Cyperus bulbosus* Vahl.	Cyperaceae	Afr.; Ind. or	H	AqT, MoS	F
10832	*Cyperus compressus* L.	Cyperaceae	Cosmop. trop	H	MoS	F
10738	*Cyperus cyperoides* (L.) O. Kuntze	Cyperaceae	Austral	H	MoS, UpL	F
10739	*Cyperus kyllingia* Endl.	Cyperaceae	Am. austr	H	MoS, UpL	F
10813	*Cyperus pygmaeus* Rottb.	Cyperaceae	Cosmop. trop	H	MoS	F
10740	*Cyperus rotundus* L.	Cyperaceae	Cosmop	H	MoS	F
10831	*Cyperus triceps* (Rottb.) Endl.	Cyperaceae	Geront. Trop	H	MoS	F
10806	*Elaeocharis palustris* R. Br.	Cyperaceae	Europ.; Am. bor	H	AqT, MoS	F
10773	*Fibristylis falcata* (Vahl.) Kunth.	Cyperaceae	Ind. or.; Madag.; Ins. Philipp	H	MoS	F
10804	*Scirpus* sp.	Cyperaceae		H	AqT	C
10754	*Scirpus tuberosus* Des. f.	Cyperaceae	Cosmop	H	MoS	F
10741	*Dryopteris* sp.	Dryopteridaceae		F	MoS, UpL	C
10812	*Equisetum ramosissimum* Desf.	Equisetaceae	Cosmop	F	MoS, UpL	R
10892	*Euphorbia hirta* L.	Euphorbiaceae	Amphig. trop	H	UpL	F
10839	*Euphorbia prostrata* W. Ait.	Euphorbiaceae	Am. trop	H	MoS, UpL	F
10864	*Kirganelia reticulata* (Poir.) Baill.	Euphorbiaceae	Geront. Trop	S	UpL	R
10814	*Trewia nudiflora* L.	Euphorbiaceae	As. trop	T	MoS	O
10879	*Acacia catechu* Willd.	Fabaceae	Ind. or	T	MoS, UpL	R
10727	*Acacia farnesiana* Willd.	Fabaceae	Reg. trop	T	MoS	O
10862	*Acacia nilotica* (L.) Del.	Fabaceae	Afr.; As. trop	T	UpL	O

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

Table 2. Continued.

Coll. No.	Scientific name	Family	Nativity	Habit	Habitat	Status
10823	*Dalbergia sissoo* Roxb.	Fabaceae	Ind. or.; Afghan	T	MoS, UpL	F
10838	*Desmodium triflorum* (L.) DC.	Fabaceae	Cosmop. Trop	H	MoS, UpL	F
10817	*Lathyrus aphaca* L.	Fabaceae	Europ.; Oriens	H	MoS, UpL	F
10782	*Medicago lupulina* L.	Fabaceae	Geront. bor. temp	H	MoS, UpL	F
10737	*Melilotus alba* Medik.	Fabaceae	Europ.; Asia	H	MoS, UpL	F
10826	Melilotus indica All.	Fabaceae	Europ.; As. bor	H	MoS, UpL	F
10872	*Pongamia pinnata* (L.) Pierre	Fabaceae	As. trop.; Austral.; Ins. Pacif	T	UpL	O
10756	*Trifolium tomentosum* L.	Fabaceae	Reg. Mediterr	H	MoS, UpL	F
10757	*Trigonella foenum-graecum* L.	Fabaceae	Europ.; Oriens	H	MoS, UpL	O
10874	*Trigonella hamosa* L.	Fabaceae	Aegypt	H	UpL	F
10733	*Vicia hirsute* (L.) SF. Gray	Fabaceae	Europ.; As. et Afr. bor	H	MoS, UpL	F
10734	*Vicia sativa* L.	Fabaceae	Europ.; Afr. bor.; Oriens	H	MoS, UpL	F
10857	*Vicia tetrasperma* (L.) Moench.	Fabaceae	Europ.; Oriens	H	UpL	O
10861	*Exacum pedunculatum* L.	Gentianaceae	Ind. or	H	UpL	R
10716	*Hydrilla verticillata* (L.f.) Royle	Hydrocharitaceae	Ind. or	H	AqT	F
10709	*Vallisneria natans* (Lour) Hara	Hydrocharitaceae	Reg Temp. et Calid.	H	AqT	C
10860	*Leucas cephalotes* (Roth.) Spreng.	Lamiaceae	Ind. Or	H	UpL	R
10766	*Nepeta hindostana* (Roxb.) Haires	Lamiaceae	Europ.; Oriens	H	MoS, UpL	O
10877	*Perilla frutescens* (L.) Britt.	Lamiaceae	India (Indian Sub-continent, Asia trop.)	H	UpL	F
10825	*Salvia plebeia* R. Br.	Lamiaceae	As. or.; Austral	H	MoS	F
10722	*Lemna perpusilla* Torrey	Lemnaceae	Am. bor	H	AqT	F
10809	*Spirodela polyrhiza* (L.) Schl.	Lemnaceae	Europe	H	AqT	F
10898	*Linum usitatissimum* L.	Linaceae	Europ.; Oriens	H	UpL	R
10745	*Ammannia baccifera* L.	Lythraceae	Geront. calid	H	MoS	F
10803	*Rotala densiflora* Koehne	Lythraceae	Geront. trop	H	AqT, MoS	F
10878	*Malvastrum coromandelianum* (L.) Garcke	Malvaceae	Cosmop. Trop	H	UpL	F
10895	*Sida rhombifolia* L.	Malvaceae	Amphig. trop	H	UpL	F
10789	*Urena lobata* L.	Malvaceae	Cosmop. trop	S	MoS, UpL	F
10810	*Marslea quadriolia* L	Marseliaceae	Europa centr. et austr.-India bor. Japonia. Connecticut	H	AqT, MoS	F
10768	*Martynia annua* L.	Martyniaceae	Am. bor	H	MoS	R
10865	*Albizia procera* Benth.	Mimosaceae	As. trop.; Austral	T	UpL	O
10820	*Pithecellobium dulce* (Roxb.) Benth.	Mimosaceae	Mexico	T	MoS	R
10899	*Ficus palmata* Forsk.	Moraceae	Afr. trop. Arab.; Ind. or	S	UpL	O
10890	*Ficus racemosa* L.	Moraceae	Ind. or. Burma	T	UpL	O
10869	*Syzygium cumini* (L.) Skeels	Myrtaceae	As. et Austral. trop	T	UpL	O
10715	*Najas graminea* Del.	Najadaceae	Geront. temp. & trop	H	AqT	F
10713	*Najas minor* All.	Najadaceae	Geront. temp. et trop	H	AqT	F
10900	*Boerhavia diffusa* L.	Nyctaginaceae	India, Asia-Tropical	H	UpL	R
10714	*Nymphaea nouchali* Burm.f.	Nymphaeceae	As. et Afr. trop	H	AqT	O
10711	*Nymphoides cristata* (Roxb.) Kuntze	Nymphaeceae	Ind. or.; China	H	AqT	F
10710	*Nymphoides indica* (L.)Kuntze	Nymphaeceae	Ind. or.; China	H	AqT	F
10712	*Ludwigia adscendens* (L.) Hara	Onagraceae	Amphig. Trop	H	AqT, MoS	F
10870	*Zeuxine strateumatica (L.) Schl.*	Orchidaceae	Ind. or.; Malaya; China	H	UpL	F

LISTS OF SPECIES

Table 2. Continued.

Coll. No.	Scientific name	Family	Nativity	Habit	Habitat	Status
10840	*Oxalis corniculata* L.	Oxalidaceae	Amphig. temp. et trop	H	MoS, UpL	F
10783	*Argemone mexicana* L.	Papaveraceae	Am. bor.; Mexic	H	MoS, UpL	O
10796	*Avena sativa* L.	Poaceae	Terr. temp. (oult.)	H	MoS, UpL	F
10778	*Brachiaria distachya* (L.) Stapf.	Poaceae	As. et Austral. Trop	G	MoS, UpL	F
10742	*Brachiaria ramosa* (L.) Stapf.	Poaceae	Ind. Or	G	MoS	F
10798	*Cynodon dactylon* (L.) Pers.	Poaceae	Cosmop	G	MoS, UpL	F
10830	*Eleusine indica* (L.) Gaertn.	Poaceae	Cosmop. trop. et subtrop	G	MoS, UpL	F
10867	*Imperata cylindrical* (L.) P. Beauv.	Poaceae	Reg. calid	G	UpL	F
10871	*Oplismenus burmanii* (Retz.) P. Beauv	Poaceae	Amphig. Trop	H	UpL	F
10819	*Phalaris minor* Retz.	Poaceae	Graecia; Oriens; Afr. austr	G	MoS	O
10763	*Phragmites karka* (Retz.) Trin. ex Steud.	Poaceae	As.; Afr. Austr.	G	AqT, MoS, UpL	F
10751	*Polypogon fugax* Nees. ex Steud.	Poaceae	Amphig. trop. et temp	G	MoS, UpL	F
10828	*Saccharum bengalensis* Retz.	Poaceae	Ind. or.; China	H	MoS, UpL	F
10837	*Saccharum spontaneum* L.	Poaceae	Geront. trop	H	MoS	F
10797	*Setaria verticillata* (L.) P. Beauv.	Poaceae	Cosmop	H	MoS, UpL	F
10801	*Triticum vulgare* Vill.	Poaceae	Cosmop. (cult.)	H	MoS, UpL	F
10750	*Polygonum barbatum* L.	Polygonaceae	Ind. or	H	AqT, MoS, UpL	F
10807	*Polygonum glabrum* Willd.	Polygonaceae	Reg. trop	H	AqT, MoS	F
10706	*Polygonum hydropiper* L.	Polygonaceae	Reg. temp. bor. et austr	H	AqT, MoS	F
10707	*Polygonum lapathifolium* L.	Polygonaceae	Reg. bor. et austr	H	AqT, MoS	F
10794	*Polygonum plebeium* R. Br.	Polygonaceae	Geront. trop. et temp	H	MoS, UpL	F
10774	*Rumex dentatus* L.	Polygonaceae	Oriens; Ind. or	H	MoS, UpL	F
10753	*Rumex nepalensis* Spreng.	Polygonaceae	As. occ.; Ind. or.; Malaya; Afr. austr	H	MoS, UpL	F
10717	*Eichhornia crassipes* (Mart.) Solms.	Pontederiaceae	Am. Trop	H	AqT	F
10728	*Monochoria vaginalis* (Burm. f.) Presl.	Pontederiaceae	As. et Afr. Trop	H	AqT, MoS	O
10726	*Potamogeton crispus* L.	Potamogetonaceae	Reg. temp. bor. et austr	H	AqT	F
10724	*Potamogeton nodosus* Poir.	Potamogetonaceae	Reg. temp. et trop	H	AqT	O
10725	*Potamogeton pectinatus* L.	Potamogetonaceae	Reg. temp. bor. et austr	H	AqT	F
10746	*Anagallis arvensis* L.	Primulaceae	Europ.; As. temp	H	MoS, UpL	F
10799	*Primula umbellata* (Lour.) Bentv.	Primulaceae	China	H	MoS, UpL	F
10792	*Ranunculus muricatus* L.	Ranunculaceae	Europ.; Oriens	H	MoS, UpL	F
10708	*Ranunculus sceleratus* L.	Ranunculaceae	Reg. bor. temp	H	AqT, MoS	F
10859	*Zizyphus mauritiana* Lamk.	Rhamnaceae	Ind. or.; Malaya	T	UpL	O
10786	*Potentilla supina* L.	Rosaceae	Geront. temp. et trop	H	MoS, UpL	F
10827	*Hedyotis corymbosa* L.	Rubiaceae	Reg. trop	H	MoS, UpL	O
10780	*Wendlandia exserta* DC.	Rubiaceae	Ind. or	T	MoS, UpL	R
10703	*Bacopa monnieri* (L.) Penn.	Scrophulariaceae	Cosmop	H	AqT, MoS	R
10743	*Bacopa procumbens* (Mill.) Greenm.	Scrophulariaceae	Am. Trop	H	MoS, UpL	O
10785	*Lindernia ciliata* (Colsm.) Penn.	Scrophulariaceae	Ind. or.; Malaya; China	H	MoS, UpL	O
10843	*Mazus pumilus* (Burm. f.) Steen.	Scrophulariaceae	Ind. Or	H	MoS, UpL	F
10894	*Verbascum chinense* (L.) Santap.	Scrophulariaceae	As. or.; Austral	H	UpL	O
10759	*Veronica anagallis-aquatica* L.	Scrophulariaceae	Reg. bor. temp	H	AqT, MoS	F

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

LISTS OF SPECIES

Table 2. Continued.

Coll. No.	Scientific name	Family	Nativity	Habit	Habitat	Status
10765	*Nicotiana plumbaginifolia* Viv.	Solanaceae	Mexic	H	MoS, UpL	F
10897	*Physalis minima* L.	Solanaceae	Geront. trop	H	UpL	O
10760	*Solanum nigrum* L.	Solanaceae	Amphigaea	H	MoS, UpL	F
10873	*Solanum torvum* Sw.	Solanaceae	Cosmop. trop	H	UpL	R
10841	*Solanum viarum* Dunal	Solanaceae	Braz	H	MoS, UpL	O
10755	*Tamarix dioica* Roxb.	Tamaricaceae	Ind. or.; Burma	S	MoS, UpL	O
10720	*Trapa natans* var *bispinosa* (Roxb.)Makino	Trapaceae	Europ.; Oriens; Ind. or	H	AqT	O
10758	*Typha elephantina* Roxb.	Typhaceae	Reg. Mediterr.; Ind. or	H	AqT, MoS, UpL	F
10762	*Pouzolzia pentandra* (Roxb.) Benn.	Urticaceae	As. Trop	H	MoS	O
10752	*Pouzolzia zeylanica* (L.) Benn.	Urticaceae	As. et Austral. Trop	H	MoS	F
10721	*Utricularia* sp.	Utriculariaceae		H	AqT	C
10764	*Phyla nodiflora* (L.) Greene	Verbenaceae	Amphig. trop	H	MoS, UpL	F

Table 3: Habitat preference of plants in Baanganga wetland.

Habitat types	Species
Aquatic	*Alternanthera pheloxeroides, Azolla pinnata, Ceratophyllum dimersum, Eichhornia crassipes, Hydrilla verticillata, Lemna perpusilla, Najas graminea, Najas minor, Nymphaea nouchali, Nymphoides cristata, Nymphoides indica, Potamogeton crispus, Potamogeton nodosus, Potamogeton pectinatus, Scirpus* sp., *Spirodela polyrhiza, Trapa natans* var *bispinosa, Utricularia* sp., and *Vallisneria natans*
Seasonally inundated shore	*Acacia farnesiana, Ammannia baccifera, Brachiaria ramosa, Cyperus compressus, Cyperus pygmaeus, Cyperus rotundus, Cyperus triceps, Fibristylis falcata, Grangea maderaspatana, Hydrocotyle sybthorpioides, Ipomoea* sp., *Martynia annua, Oxystelma secamone, Phalaris minor, Pithecellobium dulce, Pouzolzia pentandra, Pouzolzia zeylanica, Saccharum spontaneum, Salvia plebeia, Scirpus tuberosus, Stellaria media, Tamarindus indica, Terminalia arjuna, Trewia nudiflora,* and *Vernonia cinerea*
Upland	*Acacia nilotica, Albizia procera, Amaranthus spinosus, Blumea membranacea, Blumea mollis, Boerhavia difusa, Campanula wallichii, Cordia dichotoma, Elephantopus scaber, Euphorbia hirta, Exacum* sp., *Ficus palmata, Ficus racemosa, Imperata cylíndrica, Ixeris polycephala, Kirganelia reticulata, Launea procumbens, Leucas cephalotes, Linum usitatissimum, Malvastrum coromandelianum, Oplismenus burmanii, Perilla frutescens, Physalis minima, Pongamia pinnata, Pulicaria crispa, Rungia pectinata, Sida rhombifolia, Solanum torvum, Sonchus oleracea, Syzygium cumini, Trigonella hamosa, Verbascum chinense, Vicia tetrasperma, Xanthium strumarium, Zeuxine strateumatica, Zizyphus mauritiana,* and *Zizyphus nummularia*

Cover

In aquatic, seasonally inundated shore and upland habitats the dominant plants were 25, 26 and 18, respectively and the percent cover of each species is given in Table 4. The cover percentage of dominant plants in aquatic zone was high for *Eichhornia crassipes*, *Azolla pinnata*, *Spirodela polyrhiza*, and *Vallisneria natans* and ranged form 66-81 %, in seasonally inundated shore for *Ranunculus sceleratus*, *Ipomoea carnea*, *Phragmites karka*, *Enydra fluctuans*, and *Commelina benghalensis* and ranged from 44-69 % and in upland habitat for *Imperata cylindrica*, *Zeuxine strateumatica*, *Cynodon dactylon*, *Typha elephantina*, *Ageratum houstonianum*, and *Alternanthera sessilis* and ranged from 27-38 %.

During the field survey it was observed that various type of weeds, e.g. emergent (*Typha*, *Phragmites*, *Cyperus* and *Ipomoea*), floating (*Ludwigia*, *Eichhornia*, *Lemna, Spirodela*, *Azolla*, *Polygonum*, *Sagittaria*, and *Nymphaea*) and submerged (*Hydrilla*, *Potamogeton*, *Vallisneria*,

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

and *Ceratophyllum*), have been impacted Baanganga wetland very heavily due to their proliferation by reducing water storage; impede water flow, fish production and aesthetic value. The proportion of area covered by major weeds in the study area is as follows: *Typha* > *Phragmites* > *Eichhornia* > *Vallisneria* > *Enydra* > *Azolla*. Being habitat specific these weeds occupying habitats as per their need, *Typha* on upland habitat, *Phragmites* mainly in islands and others in water body.

As *Typha* and *Phragmites* in the study area does not have any adverse effect on wildlife (swamp deer, hog deer and birds), while they provide shelter to them. All water loving species (*Eichhornia*, *Vallisneria*, *Enydra*, and *Azolla*) are present in few localities with large masses, which may create problem for fishes. Therefore, to control *Vallisneria* growth where it covers large areas, the plants may be uprooted or the excessive vegetative growth may be pruned during April, just before the commencement of flowering season and should be continued for a month period to resolve the problem. *Eichhornia* and *Azolla* are closely associated with each other and formed a huge reservoir of weed in the upper part of Baanganga River and clogged the area. This is mainly due to the widening of the area, which reduces the water flow. Once the weed stayed for a longer duration in these areas, then they propagate rapidly and chocking the area, and left over areas are covered by *Azolla*. For the mitigation of the problem, identification of such areas and their routine pruning by taking out old vegetative portion, which are capable of producing small plants by vegetative means, is must. Taking out whole *Eichhornia* patch may lead to loss of biodiversity, as it provides vantage point for fishing and resting place to many birds as well as escape cover to many fishes, frogs and reptiles (snake and turtle). By leaving small patches of *Eichhornia* in between will help in maintaining the diversity of flora and fauna in the river as well as river flow. *Enydra fluctuans*, an emergent weed blocking few areas, which does not allow consistent movement to waterfowls, fishes and water. To reduce the proliferation of this deep rooted weed, monthly deep clipping is must.

Along the shore and on the edge of the islands *Ipomoea carnea* proliferating with excessive growth, which is sometimes beneficial for birds to nest and animals to rest and hide, while it restricts the growth of other plants. Sometimes self pruning was observed in dense patches of *Ipomoea.* To control the proliferation of *Ipomoea* along the shore and edge of the islands stems may be cut randomly after a gap of two months, which will not affect the ecosystem. A ground orchid, *Zeuxine strateumatica* was observed in large quantity (29.6±9.3 individuals m^{-2}) and interspersed with *Typha* patch, should be protected from disturbance, mainly cattle grazing. It was observed that the trees are very less along the Baanganga River, which is good for birds' roosting. The trees like *Terminalia arjuna*, *Trewia nudiflora*, and *Syzygium cumini* can be planted along the shore as well as in the centre of islands (not necessarily in each island) in such a way by keeping the area in mind. As the mentioned trees have good germination ability, therefore, seasonal monitoring is required to check the unwanted tree seedling germination in the islands and along the shore by uprooting them.

The fishermen choking the river along the sides, where water is deep through *Eichhornia* to get good amount of fish, however, it hampers the movement of other floating plants as well as restrict the amount of dissolved oxygen in water. Therefore, the practice of blocking through *Eichhornia* may be discouraged. The Baanganga wetland historically being used by the transhumant pastoralists, mainly from the adjacent state of Haryana seems to be a threat, as grazing hampers the growth of native flora through trampling and overgrazing and provide suitable habitat for the seeds of various weed species, which are carried by livestock. Therefore, a mechanism may be evolved for the grazing in the area, such as rotational grazing or by opening certain areas for grazing.

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

LISTS OF SPECIES

Table 4. Cover percent of dominant species in different habitat types in Baanganga wetland.

Species	Habitat type		
	Aquatic	Seasonal inundated shore	Upland
Ageratum conyzoides	-	17.0 ± 7.6	23.0 ± 10.3
Ageratum houstonianum	-	21.0 ± 9.4	28.0 ± 12.5
Alternanthera paronychioides	-	26.0 ± 11.6	13.0 ± 5.8
Alternanthera sessilis	-	20.0 ± 8.9	27.0 ± 12.1
Azolla pinnata	79.0 ± 35.3	-	-
Ceratophyllum dimersum	59.0 ± 26.4	-	-
Commelina benghalensis	-	44.0 ± 19.7	21.0 ± 9.4
Cynodon dactylon	-	27.0 ± 12.1	30.0 ± 13.4
Cyperus pygmaeus	-	29.0 ± 13.0	-
Cyperus rotundus	-	21.0 ± 9.4	-
Eichhornia crassipes	81.0 ± 36.2	-	-
Enydra fluctuans	57.0 ± 25.5	51.0 ± 22.8	-
Hydrilla verticillata	56.0 ± 25.0	-	-
Imperata cylindrica	-	-	38.0 ± 17.0
Ipomoea carnea	19.6 ± 8.8	55.2 ± 24.7	24.8 ± 11.1
Lemna perpusilla	47.0 ± 21.0	-	-
Ludwigia adscendens	26.0 ± 11.6	34.0 ± 15.2	-
Marsilea quadriolia	22.0 ± 9.8	38.0 ± 17.0	-
Melilotus alba	-	33.0 ± 14.8	16.0 ± 7.2
Momordica dioica	-	22.0 ± 9.8	12.4 ± 5.5
Najas graminea	37.0 ± 16.5	-	-
Najas minor	31.0 ± 13.9	-	-
Nymphoides cristata	63.0 ± 28.2	-	-
Nymphoides indica	49.0 ± 21.9	-	-
Phragmites karka	24.2 ± 10.8	52.6 ± 23.5	22.4 ± 10.0
Phyla nodiflora	-	27.0 ± 12.1	19.0 ± 8.5
Polygonum barbatum	15.8 ± 7.1	29.6 ± 13.2	20.2 ± 9.0
Polygonum hydropiper	21.0 ± 9.4	29.0 ± 13.0	12.4 ± 5.5
Polygonum lapathifolium	23.0 ± 10.3	29.0 ± 13.0	
Polygonum plebeium	-	20.0 ± 8.9	17.0 ± 7.6
Potamogeton crispus	62.0 ± 27.7	-	-
Potamogeton pectinatus	49.0 ± 21.9	-	-
Ranunculus sceleratus	21.0 ± 9.4	69.0 ± 30.9	-
Rorippa nasturtium-aquaticum	34.0 ± 15.2	26.0 ± 12.0	-
Rumex dentatus	-	28.0 ± 12.5	16.0 ± 7.2
Sagitaria sagitifolia	31.0 ± 13.9	24.0 ± 10.7	-
Scirpus tuberosus	-	22.0 ± 9.8	-
Spirodela polyrhiza	71.0 ± 31.8	-	-
Typha elephantina	18.4 ± 8.2	25.0 ± 11.2	29.6 ± 13.2
Vallisneria natans	66.0 ± 29.5	-	-
Zeuxine strateumatica	-	-	33.0 ± 14.8

Acknowledgements

The authors are thankful to the Director, Dean, Dr. G.S. Rawat and Shri S. Chandola, CWLW for their encouragement, guidance, suggestions, and facilities at Wildlife Institute of India, Dehradun and Uttarakhand Forest Department, respectively. Thanks are also due to DFO, RFO and field staff of Haridwar Forest Division for their untiring help throughout the field work. The authors are thankful to Dr. Frederico Augusto Guimarães Guilherme, who critically reviewed the paper.

Check List **4**(3): 279–290, 2008.
ISSN: 1809-127X

LISTS OF SPECIES

Literature cited

Allen-Diaz, B., R. D. Jackson, K. W. Tate, and L. G. Oates. 2004. California Agriculture 58(3): 144-148.

Anonymous. 1883-1885 and 1886-1970. *Index Kewensis Plantarum Phanerogamarum*. Vol. I-II and 15 suppl. Oxford: Clarendon Press.

Babu, C. R. 1977. Herbaceous Flora of Dehradun. CSIR Publication, New Delhi.

Duthie, J. F. 1903-29. Flora of the Upper Gangetic Plain and of the Adjacent Siwalik and Sub Himalayan Tracts, I-III, 1049.

Naskar, K. R. 1990. Aquatic and semi-aquatic plants of the lower Ganga delta, Daya Publishing House, Delhi.

Prasad, V. P., D. Mason, J. E. Marburger, and C. R. Ajith Kumar. 1996. Illustrated Flora of Keoladeo National Park, Bharatpur, Rajasthan. BNHS, Oxford: Oxforf University Press.

Received February 2008
Accepted June 2008
Published online August 2008